theories already before the scientific public, which fulfil this essential condition, and I now publish a *sixth* mechanical theory, not because I think it superior to its predecessors, but in order, if possible, to direct attention to the unscientific state in which the question rests. It may be useful, with this view, to mention the various theories, which I shall do in chronological order: — First, Fresnel's theory; second, M. Cauchy's theory, deduced from the mathematical equations of motion of a system of attracting and repelling molecules; third and fourth, two theories of Mr. George Green, published in 1839; fifth, the late Professor Mac Cullagh's theory, published in the same year. To these may be added the theory now published. The existence of *five* rival theories is a formidable objection to each of the six, and until this objection is removed, none can claim to be the theory of Light.

"The *experimenta crucis* must be sought for in the laws of reflexion and refraction, as I have shown in my former paper. I am at present engaged in the investigation of the laws of reflexion, with the view of testing by experiment, if possible, the six theories of light. It may be interesting to observe, with respect to the direction of vibration, that in M. Cauchy's theory the vibrations are neither normal nor transversal, that in Fresnel's and Mr. Green's second theory, the vibrations are perpendicular to the plane of polarization, and that in Mr. Green's first theory, Professor Mac Cullagh's, and my own, the vibrations are parallel to the plane of polarization."

The Rev. Samuel Haughton communicated also the following note on the function peculiar to a system of attracting and repelling molecules.

"In my memoir on the equilibrium and motion of solid and fluid bodies, I have deduced the function from the supposition that the natural state of the body is one of free equilibrium.

The function deduced from this supposition contains *fifteen* coefficients only. It may be thus written:

$$\left.\begin{aligned} 2\Phi = {} & A\alpha_1^2 + B\beta_2^2 + C\gamma_3^2 + Lu^2 + Mv^2 + Nw^2 \\ & + 2(L\beta_2\gamma_3 + M\alpha_1\gamma_3 + N\alpha_1\beta_2) + 2(U_1vw + V_2uw + W_3uv) \\ & + 2u(U_1\alpha_1 + V_1\beta_2 + W_1\gamma_3) + 2v(U_2\alpha_1 + V_2\beta_2 + W_2\gamma_3) \\ & + 2w(U_3\alpha_1 + V_3\beta_2 + W_3\gamma_3); \end{aligned}\right\} \quad (1)$$

where

$$\alpha_1 = \frac{d\xi}{dx},\ \beta_2 = \frac{d\eta}{dy},\ \gamma_3 = \frac{d\zeta}{dz},$$

$$u = \frac{d\eta}{dz} + \frac{d\zeta}{dy},\ v = \frac{d\zeta}{dx} + \frac{d\xi}{dz},\ w = \frac{d\xi}{dy} + \frac{d\eta}{dx}.$$

In the case of a homogeneous solid, this function will give Navier's equations containing only one constant.

"On examining the equations of a system of attracting and repelling molecules, obtained by a different process by M. Cauchy, I found them to contain *twenty-one* coefficients, and concluded from a hasty examination, that they could be derived from the function (1), by introducing six different constants or coefficients of $\beta_2\gamma_3$, $\alpha_1\gamma_3$, $\alpha_1\beta_2$, vw, uw, uv; which would make function (1) identical with Mr. Green's function for light. I supposed, therefore, that Mr. Green's equations were the same as M. Cauchy's, and consequently, in my classification of elastic media have called Mr. Green's function, the function of a system of attracting and repelling molecules. A more attentive consideration of M. Cauchy's equations has convinced me that this is an error, and that Mr. Green's equations do not represent the equations of a system of attracting and repelling molecules.

"It has now become necessary for me to show how M. Cauchy's equations may be derived from the principles laid down in my first memoir. This is easily done as follows:

"Referring to the memoir,* we find, adopting the notation so often described,

$$\rho + \rho' = \sqrt{\left\{ \begin{array}{c} (a + a\alpha_1 + b\alpha_2 + c\alpha_3)^2 + (b + a\beta_1 + b\beta_2 + c\beta_3)^2 \\ + (c + a\gamma_1 + b\gamma_2 + c\gamma_3)^2. \end{array} \right\}}$$

Assuming now

$$\lambda = \alpha_1^2 + \beta_1^2 + \gamma_1^2, \quad \mu = \alpha_2^2 + \beta_2^2 + \gamma_2^2, \quad \nu = \alpha_3^2 + \beta_3^2 + \gamma_3^2,$$
$$\phi = \alpha_2\alpha_3 + \beta_2\beta_3 + \gamma_2\gamma_3, \quad \chi = \alpha_3\alpha_1 + \beta_3\beta_1 + \gamma_3\gamma_1, \quad \psi = \alpha_1\alpha_2 + \beta_1\beta_2 + \gamma_1\gamma_2,$$

and developing the square root, we obtain:

$$\rho + \rho' =$$
$$\rho \left\{ \begin{array}{l} 1 + (\alpha_1\cos^2\alpha + \beta_2\cos^2\beta + \gamma_3\cos^2\gamma + u\cos\beta\cos\gamma + v\cos\gamma\cos\alpha + w\cos\alpha\cos\beta) \\ \quad + \frac{1}{2}(\lambda\cos^2\alpha + \mu\cos^2\beta + \nu\cos^2\gamma + 2\phi\cos\beta\cos\gamma + 2\chi\cos\gamma\cos\alpha + 2\psi\cos\alpha\cos\beta) \\ \quad + (\alpha_1\cos^2\alpha + \beta_2\cos^2\beta + \gamma_3\cos^2\gamma + u\cos\beta\cos\gamma + v\cos\gamma\cos\alpha + w\cos\alpha\cos\beta)^2 \end{array} \right\} (2)$$

neglecting terms of a higher order than the second.

"The function arising from this expansion will be (*vid.* Transactions of the Academy, vol. xxi. p. 153):

$$\left. \begin{array}{l} 2V = 2(G\alpha_1 + H\beta_2 + I\gamma_3) + Du + Ev + Fw \\ \quad + (G\lambda + H\mu + I\nu + D\phi + E\chi + F\psi) \\ \quad + 2\Phi \end{array} \right\} (3)$$

where Φ denotes function (1),

$$2G = \iiint F_0\rho\cos^2\alpha d\omega \qquad 2H = \iiint F_0\rho\cos^2\beta d\omega$$
$$2I = \iiint F_0\rho\cos^2\gamma d\omega$$
$$D = \iiint F_0\rho\cos\beta\cos\gamma d\omega \qquad E = \iiint F_0\rho\cos\gamma\cos\alpha d\omega$$
$$F = \iiint F_0\rho\cos\alpha\cos\beta d\omega,$$

$d\omega$ being the element of the volume.

"This function (3) contains twenty-one coefficients, and is quite distinct from the function which may be derived from Φ, by introducing arbitrary coefficients. If the terms G, H, I, D, E, F, be retained, the natural state of the body will not be one of free equilibrium, and the equations of a homogeneous body

* Transactions of the Royal Irish Academy, vol. xxi. p. 155.

derived from (3) will contain two arbitrary constants, which appears to be more in accordance with the recent experiments of MM. Wertheim, Strehlke, and Kirchhoff, than the original result of M. Navier, which makes the equations of a homogeneous solid depend upon a single constant. If in function (3) G, H, &c., be constants, the linear part of the function will produce no terms in the equations of motion, which will become identical with the equations given by M. Cauchy for a system of attracting and repelling molecules, when we do not suppose the natural condition to be one of free equilibrium."*

Mr. Donovan read a notice of the analysis of certain gold-coloured bronze antiquities found at Dowris, near Parsonstown, in the King's County.

"At a late meeting of the Academy a communication was made by Thomas L. Cooke, Esq., of Parsonstown, relative to certain ancient bronze articles found at Dowris in the King's County. Some specimens having been, by that gentleman, placed in my hands for analysis, I deem it proper to lay before the Academy the results of my investigation. The articles given to me were part of a celt and a portion of a horn.

"The golden hue of these ancient bronzes suggested to some persons the idea that they contained an admixture of zinc, an ingredient not hitherto, I believe, found to enter into their composition. Such bronzes in the British Museum as have been analysed consist of copper and tin only; and the Greek and Roman bronze coins are known to have been composed of the same metals. Bishop Watson, it is true, supposed that zinc constituted a part of a celt examined by him, his proof being that the metal, when melted, emitted a thick, white smoke, accompanied by a blue flame, which are esteemed,

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* Exercices de Mathematiques, vol. iv. p. 131.